IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Philippe Guyot-Sionnest	
Serial No. 09/694,090	Examiner Nikolas J. Uhlir
Filing Date: October 19, 2000	Group Art Unit No. 1773
For DOPED SEMICONDUCTOR NANOCRYSTALS	

The Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313

DECLARATION PURSUANT TO 37 CFR 1.132

I, Philippe Guyot-Sionnest, declare as follows:

1. I am a professor in the departments of chemistry and physics at The University of Chicago, Chicago, IL. I received a Ph.D. from University of California, Berkeley. As a professor and principal investigator for a research laboratory, I have worked in a variety of areas including the areas of quantum confined semiconductors and semiconductor nanocrystals. I am a person of skill in the art in the field of semiconductor nanocrystals.

2. I am a co-inventor of the subject matter claimed in the above-identified U.S. Patent Application ("the application").

3. I have reviewed and understand the contents of the application, including the disclosure and the claims. With respect to the claims, I have reviewed the claims as originally filed, as previously amended, and as amended in the Amendment and Request for Reconsideration filed herewith.

4. Having reviewed and understood the application, I believe that the application discloses methods for making and using a wide variety of doped semiconductor nanocrystals. I further believe that these methods are broadly applicable to semiconductor nanocrystals and are not limited to the specific CdS, CdSe and ZnO materials disclosed in the "EXAMPLES" section on pages 11-15 of the application, nor are the methods limited to the general class of II-VI semiconductors (also referred to as 2-6 semiconductors) encompassing these specific materials.

5. This belief regarding the disclosure of the application is based on the following facts, listed in points 6 – 7 below.

6. The methods disclosed in the application have been used by others in the field to make doped semiconductor nanocrystals from indium phosphide (InP), a III-V semiconductor material. These doped semiconductor nanocrystals were reported in Blackburn, Jeff L. et al. *J. Phys. Chem. B* **2003**, *107*, 102-109 ("Blackburn"), a copy of which is attached as Appendix A.

(a) The methods used to convert neutral InP nanocrystals into *n*-type doped nanocrystals is described in Blackburn, on page 103, left-hand column, in the paragraph having the heading "Preparation of *n*-Type Nanocrystals." The treatment of InP nanocrystals with a solution of sodium biphenyl, as described in Blackburn, is substantially identical to the methods described in the application, for example at page 6, lines 17-29 and at page 13, lines 5-12.

(b) The Blackburn article discusses the doped InP nanocrystals prepared by this method on pages 107-108, in the section having the heading "*N*-Type Nanocrystals : Relaxation in the Absence of Holes." In this section, the references numbered 20 and 21 are cited as teaching that electrons can be injected successfully into the conduction band (CB) of CdSe nanocrystals (quantum dots). Copies of these references are attached as Appendix B (Shim, W. et al. *J. Phys. Chem. B* **2001**, *105*, 2369) and as Appendix C (Shim, W. et al. *Nature* **2000**, *407*, 981). Both of these references disclose work performed by

me, together with the co-inventors of the application, M. Shim and C. Wang. The methods disclosed in these references are substantially identical to the methods described in the application, for example at page 6, lines 17-29 and at page 13, lines 5-12.

7. The methods disclosed in the application have been used to make doped semiconductor nanocrystals from lead selenide (PbSe), a IV-VI semiconductor material. These doped semiconductor nanocrystals were reported in Wehrenberg, Brian L. et al. *J. Am. Chem. Soc.* **2003**, *125*, 7806-7807 ("Wehrenberg"), a copy of which is attached as Appendix D.

(a) The methods used to convert neutral PbSe nanocrystals into either *n*-type or *p*-type doped nanocrystals is described in Wehrenberg, on page 7806, left-hand column, third paragraph. The treatment of PbSe nanocrystals by electrochemical reaction in an electrolyte, as described in Wehrenberg, is substantially identical to the methods described in the application, for example at page 6, line 30 through page 7, line 10.

(b) The Wehrenberg article discloses the use of negative potentials in the electrochemical reaction to form *n*-type nanocrystals and the use of positive potentials to form *p*-type nanocrystals. This is illustrated in Figure 1 of the article and the accompanying discussion at page 7806, right-hand column through the end of the first paragraph of pate 7807, left-hand column.

8. The disclosure of the application provides sufficient breadth and specificity to enable a researcher in this field to dope a semiconductor nanocrystal successfully. Using the methods and techniques disclosed in the application, researchers have doped at least three distinct types of semiconductor materials – II-VI, III-V, and IV-IV. Moreover, using the methods and techniques disclosed in the application, researchers have doped semiconductor nanocrystals with either holes or electrons. In all cases, the quantum confined state of the carriers in the semiconductor

nanocrystals can be detected at room temperature and in the absence of an applied electric field.

9. I declare that all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the above applications or any patent granted therein.

Philippe Guyot-Sionnest

Jan 14, 2003

Date